

A photograph showing a man lying on his back, receiving medical attention. He has a large, bloody wound on his forehead and a visible ear injury. Two people wearing blue gloves are attending to his head. The background is dark and indistinct.

TRAUMATIC BRAIN INJURY - TBI

Afghan National Army medics work to stabilize an Afghan policeman with head trauma from an improvised explosive device blast at the BAS on FOB Nalay, Sangin, Afghanistan, 2013.

The background image shows a person lying on a surface, possibly a gurney, with their head and neck exposed. Two individuals wearing white medical gloves are performing a procedure or examination on the person's head and neck. The scene appears to be a medical or emergency setting. The text 'OVERVIEW' is overlaid on the upper portion of the image.

OVERVIEW

- Anatomy of the Head
- Head Injuries
- Mandatory Events Requiring TBI Evaluation
- Physiology, Signs, and Symptoms of Traumatic Brain Injury
- Components of MACE Exam
- Responder Treatment of TBI
- SIGACT Report



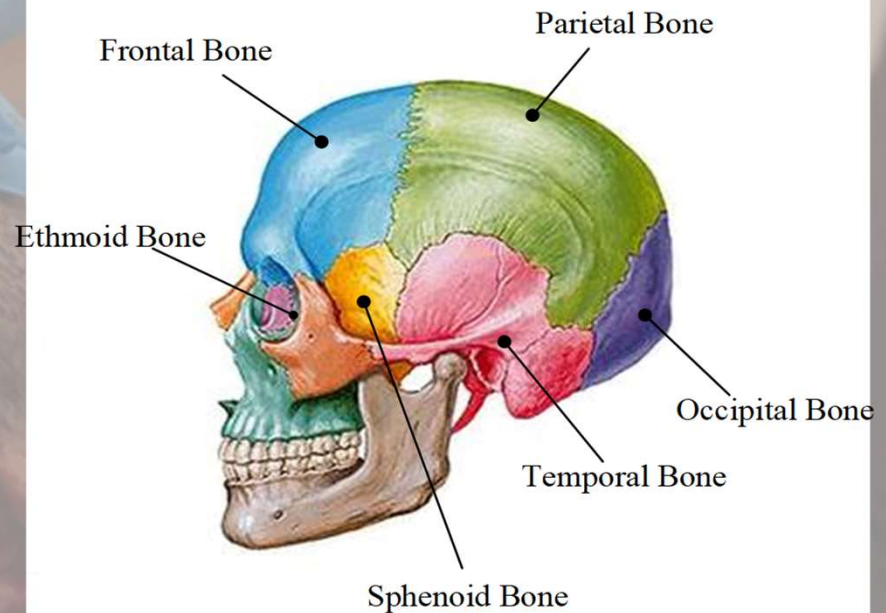
LEARNING OBJECTIVES

Please Read Your
Terminal Learning Objectives
And
Enabling Learning Objectives



ANATOMY OF THE HEAD

Occipital bone
Temporal bone
Parietal bone
Frontal bone
Sphenoid bone
Ethmoid bone





THE BRAIN

The Brain is Divided into three major areas:

The Cerebrum-The largest of the three subdivisions of the brain, superiorly situated and sometimes called the “gray matter”.

It controls willfull movement, sensory information such as hearing, speech, visual perception, emotions and personality.

The Cerebellum

Situated posteriorly to the brain stem and is sometimes called the “little brain” or “white matter”.

It coordinates the various activities of the brain, particularly movement, coordination and balance.

THE BRAIN STEM

Broken down into four parts:

- Medulla. The most inferior part of the stem which contains the center that regulates respiratory rate, blood pressure, heart rate, breathing, swallowing and vomiting.
- Pons. Sleep center and respiratory center.
- Midbrain. Regulates muscle tone.
- Reticular Activating System. Scattered throughout the brain stem and is important in arousing and maintaining consciousness.

Note: The brain is protected and cushioned by approx. 75 ml of an internal fluid called Cerebral Spinal Fluid (CSF). The CSF also combats infection and cleanses the brain and spinal cord.



The background image shows a medical professional wearing blue gloves, examining a patient's head. A flashlight is being used to inspect the scalp area. The scene is dimly lit, focusing on the examination area.

TYPES OF HEAD INJURIES

Soft Tissue injuries:

Injury to the overlying skin of the scalp, which may be in combination with injury to the skull and/or face.

- Penetrating Trauma (rifle, impaled objects, blunt trauma (MVA, Blast))

• Signs and Symptoms:

- Profuse bleeding
- Lacerations
- Avulsions
- Pain
- Anxiety
- Edema
- Ecchymosis
- Signs and Symptoms of Hypovolemic Shock



SKULL INJURIES

Open skull injuries:

Injuries where cerebral substance is visible through a scalp laceration.

- Open head injuries usually combine lacerations of the scalp, fragmentation of the skull from fractures, and lacerations of the membranes that cover the brain. The brain may be relatively untouched, or it may be extensively bruised or lacerated.
- Penetrating Trauma
- Blunt trauma (MVA, Blast)

• Signs and Symptoms:

- Profuse bleeding
- Crepitus
- Edema
- Depressions
- Deformities
- Skull or bony fragments visible

A background image showing a medical professional wearing white gloves, examining a patient's head. The patient's head is tilted back, and the professional is using a tool to inspect the back of the head. The scene is dimly lit, focusing on the examination area.

SKULL INJURIES

Closed skull injuries:

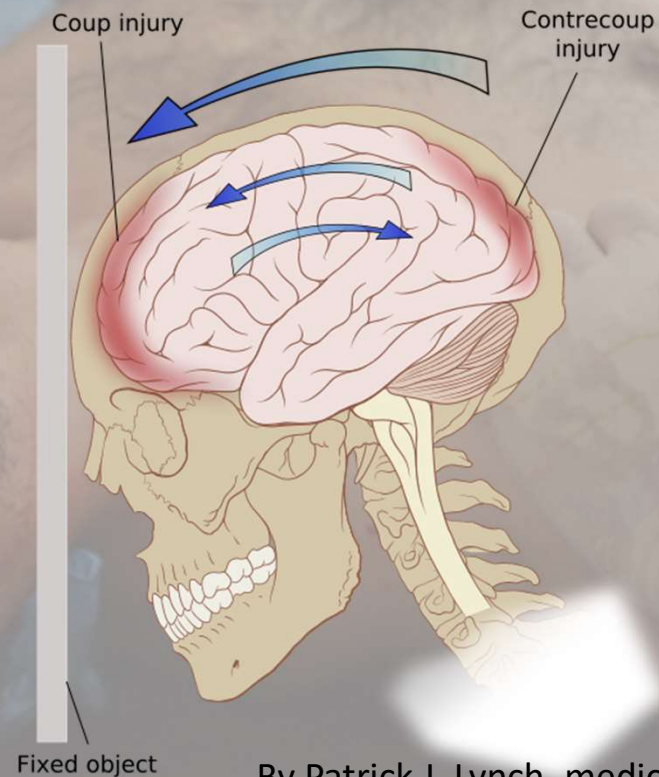
In closed head injuries there may or may not be lacerations of the scalp, but the skull is intact, and there is no opening to the brain. Injury to the brain itself may be far more extensive in a closed head injury because more of the injuring force is transmitted deeper into the brain due to pressure build-up.

• Causes:

- Coup-Contrecoup
- Blunt trauma
 - Rising Intracranial pressure produces complications because the brain is enclosed and pressure cannot be relieved.

COUP- CONTRECOUP

Coup injury occurs under the site of impact with an object,
Contrecoup injury occurs on the side opposite the area that was hit



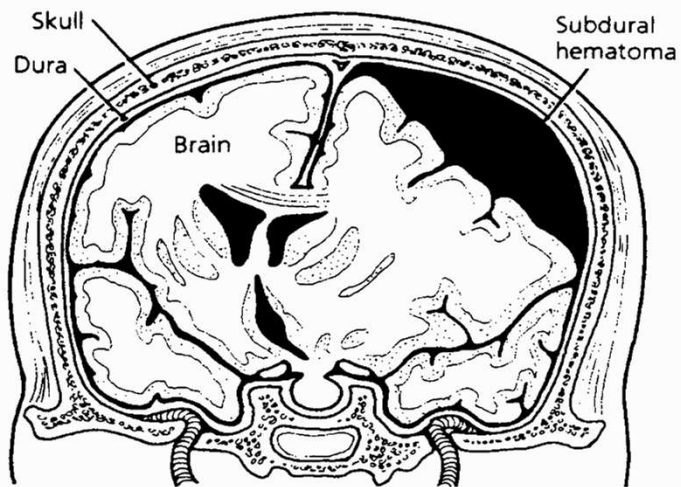
By Patrick J. Lynch, medical illustrator



INTRACRANIAL PRESSURE

- Intracranial Pressure (ICP)- pressure inside the skull, brain tissue, and cerebrospinal fluid (CSF).
 - High ICP is usually fatal if prolonged.
 - May crush brain tissue, shift brain structures, and restrict blood supply to the brain.
- High ICP S/S include:
 - Headache,
 - Vomiting *without* nausea,
 - Altered level of consciousness,
 - Visual disturbances,
 - Headache,
 - Personality or behavioral changes,
 - Hyperventilation,
 - Positive “Halo Test”.

BLUNT TRAUMA - SIGNS AND SYMPTOMS



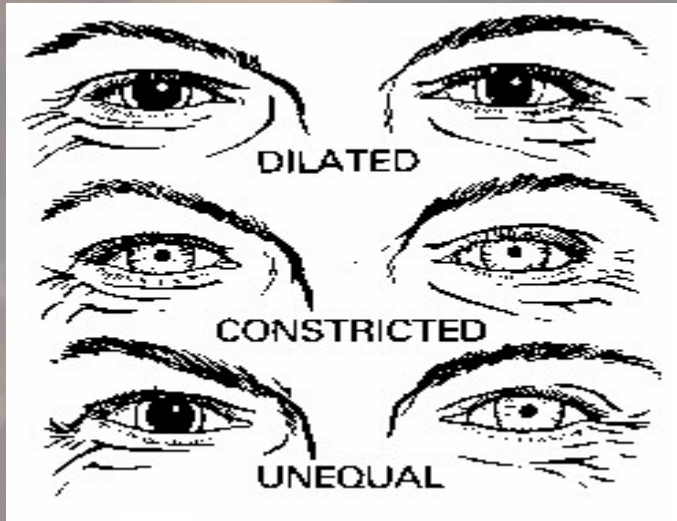
- Crepitus around injury site
- Headache
- Neurological symptoms

Altered LOC

Restlessness

Unequal pupils

BLUNT TRAUMA - SIGNS AND SYMPTOMS



- Bruising, such as:
- Raccoon Eyes - discoloration of the soft tissue under the eyes indicates basilar skull fracture.
- Battle's sign - discoloration of the soft tissue behind the ear indicates temporal bone fracture. This is a late sign and may not be readily seen.



BLUNT TRAUMA- SIGNS AND SYMPTOMS

Drainage - drainage of cerebral spinal fluid from the ears, nose, or eyes. Blood or fluid (CSF) in the ears or nose may indicate a skull fracture.

- Bradycardia
- Increased systolic blood pressure
- Nausea/vomiting
- Decreased Respirations/Cheyne Stokes breathing pattern
- Deformity of the skull

A background image showing a medical professional in blue gloves examining a patient's head. The patient's head is tilted back, and the professional is using a tool to examine the back of the head. The image is slightly blurred and has a semi-transparent overlay for text.

BRAIN INJURIES

Results from contusion, hemorrhage and or edema. Damage to the brain and associated intracranial hemorrhage may occur with or without scalp lacerations or skull fractures. If the cranial vault is intact, the resultant swelling or bleeding produces more brain injury by increasing the intracranial pressure.

Causes:

- Blunt trauma
- Penetrating trauma
- Coup-Contrecoup injuries

A background image showing a medical professional wearing blue gloves examining a patient's head. The patient is lying down, and the professional is focused on the examination. The image is slightly blurred, emphasizing the text overlay.

BRAIN INJURIES

Signs and Symptoms. In addition to the signs and symptoms for closed skull injuries, the following signs and symptoms may also indicate a brain injury:

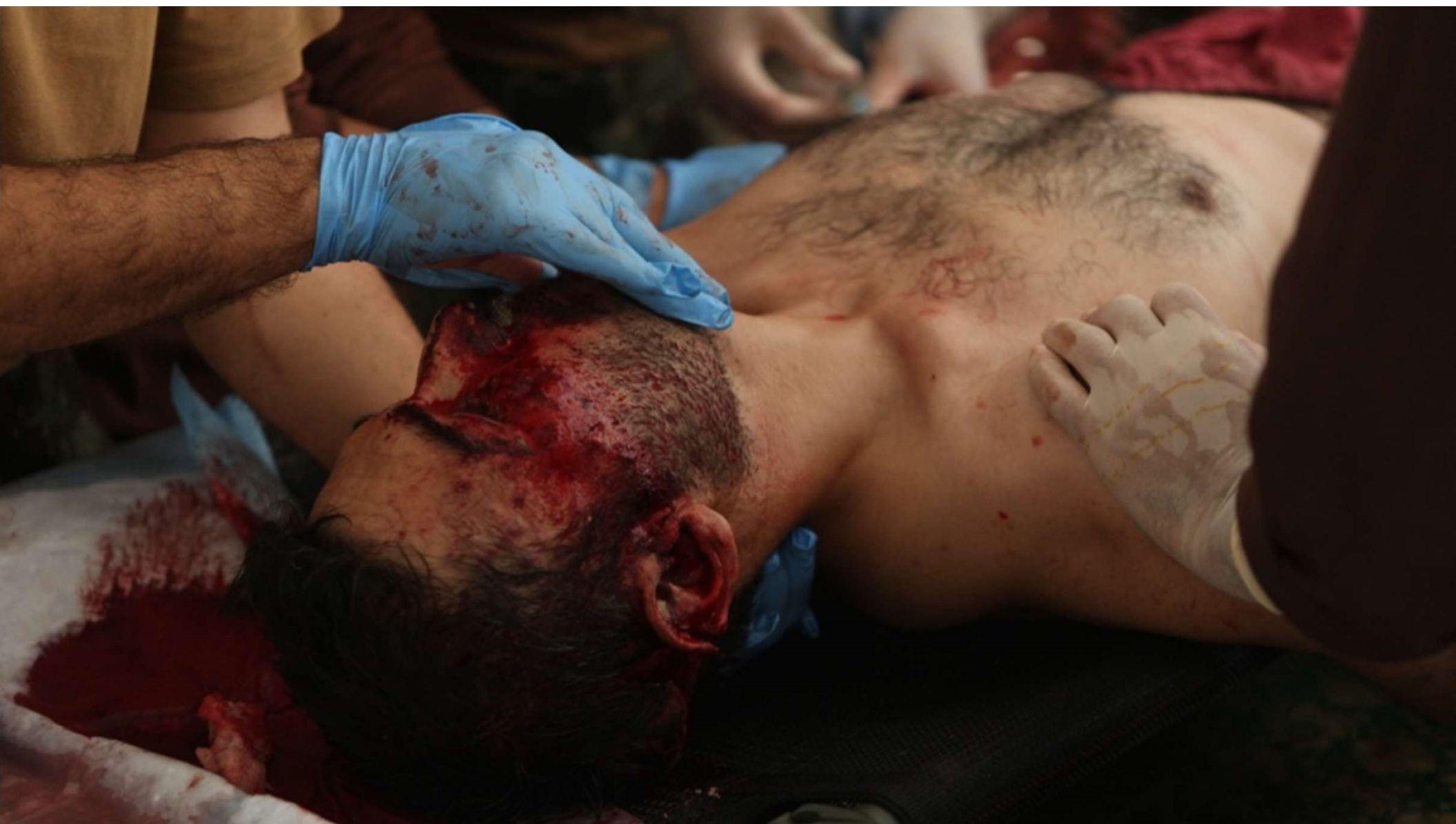
- Unusual behavior patterns. You must be careful not to misinterpret these symptoms for a psychiatric casualty. (This is the number one indicator of an injury.)
- Altered level of consciousness
- Paralysis
- Convulsions/seizures
- Hyperthermia

GLASGOW COMA SCALE (GCS)

- GCS is a neurological scale which aims to give an objective measure of consciousness.
- Serves as initial and subsequent assessments.
- Patient is assessed and given a score between 3 (deep unconsciousness) and 15 (and revised scale).

Table 1

Glasgow Coma Scale (GCS)
Eye Response (1–4)
1. No eye opening
2. Eye opening to pain
3. Eye opening to verbal command
4. Eyes open spontaneously
Verbal Response (1–5)
1. No verbal response
2. Incomprehensible sounds
3. Inappropriate words
4. Confused
5. Orientated
Motor Response (1–6)
1. No motor response
2. Stereotyped extension to pain
3. Stereotyped flexion to pain
4. Withdrawal from pain
5. Localizing pain
6. Obeys commands





TREATMENT OF HEAD INJURIES

- Provide and maintain patent airway.
- Consider c-spine precautions
- Hemorrhage control- cover open wounds securely enough to aid in the clotting process without pressing skull fragments or impaled objects inward by using donut o-ring.
- Fluid resuscitation prn
- Do not remove foreign bodies or impaled objects



TREATMENT OF HEAD INJURIES

- Check for drainage of CSF from the wound, nose, or ears.
 - Do not pack or suction nose and/or ears if CSF leakage is suspected.
 - Do not let patient clear their nose by blowing.
- There are two (2) ways to determine if fluid is CSF:
 - Use the Halo, or Target Test to check for CSF.
 - Use the Dip Stick Method. Dip a chemical urine dip stick into the blood and check for a high level of glucose. CSF contains a high level of glucose.

HALO TEST

In cases of increased ICP built up CSF may drain from ear canal.

- Dab any fluid/blood from ears/nostrils following concussive event with 2x2 gauze.
- Let gauze sit for several minutes, if a pale yellow ring forms CSF is present in sample.



A positive "Halo Test" following a motor vehicle accident.

TREATMENT OF HEAD INJURIES

- Give nothing by mouth (NPO)
- TACEVAC in the High Fowlers position.
- Pain Medications- both ketamine and Oral Transmucosal Fentanyl Citrate (OTFC) have the potential to worsen severe TBI. This fact must be taken into account when the analgesic decision is made. However, **if the casualty is able to complain of pain, then the TBI is likely not severe enough to preclude the use of ketamine or OTFC.**
- Opioids should be avoided in patients with existing respiratory issues, decrease O2 saturation, shock, or decreased level of consciousness due to risk of respiratory depression and hypotension.



TREATMENT OF HEAD INJURIES

- Communicate with the casualty if possible. Encourage, reassure, and explain care.
- Disarm patients with altered level of consciousness.
- Continuously monitor for changes in vitals or baseline.
- **NOTE:** There is a high mortality rate associated with head trauma. All head trauma patients are assumed to have a cervical spine injury until proven otherwise.





MANDATORY EVENTS REQUIRING TBI EVALUATION

- Vehicle blast, collision, or rollover
- Presence within 50 meters of a blast
- A direct blow to the head
- Exposure to more than one blast
- Prior history of concussion paired with current signs and symptoms of TBI
- Positive results on I. E. D. checklist
- Suspicion of possible TBI



PRIMARY VS. SECONDARY BRAIN INJURY

Primary Brain Injury

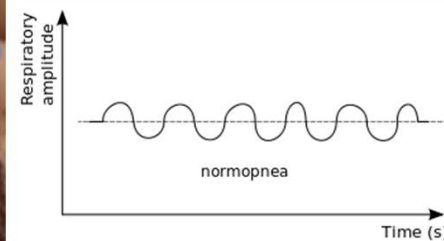
- Direct trauma to the brain and associated structures
 - Contusions
 - Hemorrhages
 - Lacerations
 - Skull fracture
 - Exposed brain matter
- Coup-Contrecoup contributes to primary injury

Secondary Brain Injury

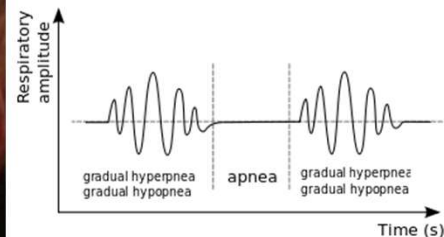
- The ongoing injury processes from primary injury
 - Increased Intracranial Pressure and associated complications
 - Hypoxia
 - Hypotension
 - Inadequate blood supply to brain

ADDITIONAL SIGNS AND SYMPTOMS

- Cheyne/Stokes respirations-
varying periods of fast deep
breathing mixed with apnea
- Battle's Sign
- Raccoon Eyes
- Asymmetric/unilateral/bilateral
pupil dilation.



Normal respiration



Cheyne-Stokes respiration

- Periodic breathing:
Gradual hyperpnea/hypopnea and Apnea
- Sleep/Hypoxemia/Drugs
- Hypoperfusion of the brain (respiratory center)

By Sav vas - Own work, CC BY-SA 3.0,

LEVELS OF TBI

Mild	Moderate	Severe
<p>Brief Loss of Consciousness</p> <ul style="list-style-type: none">• Seconds to minutes• Possibly no LOC	<p>Loss of Consciousness</p> <ul style="list-style-type: none">• Minutes to hours• Confusion for days-weeks	<p>Prolonged unconsciousness</p> <ul style="list-style-type: none">• Coma• Vegetative state• Locked in Syndrome
<p>Brain scans and testing appear normal</p>	<p>EEG/CAT/MRI are positive for brain damage</p>	<p>EEG/CAT/MRI are positive for brain damage</p>
<p>Most common</p> <ul style="list-style-type: none">• 75%-85% of brain injuries		
<p>Heals without intervention</p> <ul style="list-style-type: none">• 90% of individuals recover within 6-8 weeks	<p>Physical, cognitive, and behavioral impairments last for months or are permanent.</p>	<p>Physical, cognitive, and behavioral impairments last for years or are permanent.</p>

I. E. D. CHECKLIST

- The I.E.D Checklist is used as an informal screening tool to assess whether or not an individual requires a MACE exam or further TBI evaluation.

Injury	Physical damage to the body or body part of a Service member?	(Yes/No)
Evaluation	H – Headaches and/or vomiting?	(Yes/No)
	E – Ear ringing?	(Yes/No)
	A – Amnesia, altered consciousness, and/or loss of consciousness?	(Yes/No)
	D – Double vision and/or dizziness?	(Yes/No)
	S – Something feels wrong or is not right?	(Yes/No)
Distance	Was the Service member within 50 meters of the blast? Record the distance from the blast.	(Yes/No) Not Applicable



Components of Military Acute Concussion Evaluation (MACE) Exam

- Assesses the cognitive function following injuries.
- Assessor follows steps on cards to generate an overall "score".
- Complements Glasgow Coma Scale (GCS).
- Initiates documentation to assess initial baseline of injury as close to event as possible.
- Will be referenced throughout follow on care.

MACE - Military Acute Concussion Evaluation

Patient Name: _____ Unit: _____
 Service Member ID#: _____ Date of Injury: _____
 Examiner: _____ Time of Evaluation: _____
 Date of Evaluation: _____

CONCUSSION SCREENING
 Complete this section to determine if there was both an injury event AND an alteration of consciousness.

1. **Record the event as described by the service member or witness.**
 (Use open-ended questions to get as much detail as possible.)

Key questions:
 • "Can you tell me what you remember?"
 • "What happened?"

2. **Record the type of event.**
 Check all that apply:
☐ Explosive/blast ☐ Fragment ☐ Motor Vehicle Crash
☐ Blast Object ☐ Sports Injury ☐ Gunshot/Wound
☐ Fall ☐ Other: _____

3. **Was there a head injury event?**
☐ YES ☐ NO

Key questions:
 • "Did your head hit any object?"
 • "Did you strike your head?"
 • "Did you feel a blast wave?"
 • "Did your head hit the ground?"
 • "Did your head hit the ground?"
 • "Did your head hit the ground?"

COGNITIVE EXAM*

9. **Concentration - Reverse Digits**
 Read the digits and begin the trial by reading the first digit of numbers in Trial 1.
 • "I am going to read you a string of numbers. When I am finished, repeat them back to me in reverse order. That is, in reverse order of how I read them to you. For example, if I said 7-1-9, then you would say 9-1-7."
 Circle the response for each string.
 If correct on string length of Trial 1, proceed to the next string length in the same column.
 If incorrect on string length of Trial 1, move to the same string length of Trial 2.
 If correct on string length of Trial 1 and 2, STOP and record score as zero for that string length. Record total score as sum of previous correct trials.

REVERSE DIGITS SCORE (RA)

Trial	String	Correct
1	2-5-1	0
2	1-6-3	0
3	3-8-2-5-9	0
4	5-8-6-2-4-9	0

CONCENTRATION ALTERNATE NUMBER LISTS
 Note: Use the same list (A-F) that was used in Question 9.

String	Correct
1-2-3	0
4-5-6	0
7-8-9	0
10-11-12	0
13-14-15	0
16-17-18	0
19-20-21	0
22-23-24	0
25-26-27	0
28-29-30	0
31-32-33	0
34-35-36	0
37-38-39	0
40-41-42	0
43-44-45	0
46-47-48	0
49-50-51	0
52-53-54	0
55-56-57	0
58-59-60	0
61-62-63	0
64-65-66	0
67-68-69	0
70-71-72	0
73-74-75	0
76-77-78	0
79-80-81	0
82-83-84	0
85-86-87	0
88-89-90	0
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97-98-99	0
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1090-1091-1092	0



TREATMENT

- All individuals with moderate/severe TBI should be monitored with pulse oximetry, if possible.
- Give supplemental oxygen (if possible) to maintain an oxygen saturation of >90%.
- If a casualty with an altered mental status due to suspected TBI has a weak or absent peripheral pulse, resuscitate as necessary to maintain a palpable radial pulse.
- If BP monitoring is available, maintain a target systolic BP of at least 90 mmHg.

RESPONDER TREATMENT OF TBI

Consideration/Concern	Action
Increased ICP	Elevate the casualty's head 30 degrees
Hypoxia	Monitor O2 sat with pulse oximeter, <ul style="list-style-type: none">• If <90 provide O2 if available.
BP fluctuations	Monitor BP, Systolic BP should be >90 mmHg, <ul style="list-style-type: none">• Provide Hypertonic saline if reduced.• Gauge by radial pulse if equipment is unavailable.
Hypothermia	Monitor for Hypothermia, take action to prevent if temperature drops
Infection	Antibiotics for penetrating head trauma <ul style="list-style-type: none">• Moxifloxacin oral• Cefotetan or Ertapenum IV/IO
C-Spine Injury	<ul style="list-style-type: none">• Utilize C-Spine consideration• Administer 250cc 3 or 5% hypertonic saline bolus
Respiration difficulty	Hyperventilate the casualty



SIGACT REPORTS

Significant Activities Report

- Unit Commander required to submit SIGACT report within 24 hours of event.
- Submitted with I.E.D./MACE Assessment
- **Required for ALL blast-related events.**

SIGACT Report Consists of:

Time/Date

SIGACT Report Number

Identification: DOD ID/ZAP #

Service Member's Name

Unit Name, UIC, Home Duty Station

Combatant Command

Distance from Blast

Medical Disposition



A photograph showing a man lying on his back, receiving medical attention. He has a large, bloody wound on his forehead and a visible ear injury. Medical personnel wearing blue gloves are attending to his head. The scene appears to be outdoors or in a field setting.

TRAUMATIC BRAIN INJURY - TBI

Afghan National Army medics work to stabilize an Afghan policeman with head trauma from an improvised explosive device blast at the BAS on FOB Nalay, Sangin, Afghanistan, 2013.